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## ARTIFICIAL INTELLIGENCE AS THE BASIS FOR COGNITIVE ECONOMICS

*The paper analyzes the main approaches to creating artificial intelligence systems. Methodological principles of the artificial intelligence usage are studied in the context of the formation of a new economic knowledge-based paradigm.*

**Keywords:** artificial intelligence; cognition; cognitive economics; neurobionic approach; intellectual systems.

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## ШТУЧНИЙ ІНТЕЛЕКТ ЯК ОСНОВА КОГНІТИВНОЇ ЕКОНОМІКИ

*У статті проаналізовано основні підходи до створення систем штучного інтелекту. Досліджено методологічні принципи використання штучного інтелекту в розрізі формування нової економічної парадигми, заснованої на знаннях.*

**Ключові слова:** штучний інтелект, когнітивність, когнітивна економіка, нейробіонічний підхід, інтелектуальні системи.

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## ИСКУССТВЕННЫЙ ИНТЕЛЛЕКТ КАК ОСНОВА КОГНИТИВНОЙ ЭКОНОМИКИ

*В статье проанализированы основные подходы к созданию систем искусственного интеллекта. Исследованы методологические принципы использования искусственного интеллекта в разрезе формирования новой экономической парадигмы, основанной на знаниях.*

**Ключевые слова:** искусственный интеллект, когнитивность, когнитивная экономика, нейробионический подход, интеллектуальные системы.

**Introduction.** Activities on the creation of artificial intelligence have immediately started since the beginning of the industrial usage of computers in 2 directions. The first direction is bionic (a combination of both technical capacity of machines and biological capabilities of living beings) that attempts to simulate the activity of the brain, in particular, its physiological abilities with the hope to create a computer or special hardware of artificial intelligence. The second direction is pragmatic, when psychophysiological activity of human brain is not considered and computer is used as a tool for software and technologies' development to reproduce the processes that result from human thinking.

Due to the growing scientific interest to the problems of artificial intelligence, there have been significant positive changes in the understanding of management processes, principles of economy organization, modeling and planning of economic activities. In addition, the success achieved in the research of artificial intelligence have led to the revolution in information science, to the development of a new computer architecture and spread of intelligent systems.

Now the development of information systems and technologies aims at creating modern architecture of a computer, focused on knowledge, and the mankind has entered a new era of its development – the formation of knowledge society, therefore, the research of modern trends in the artificial intelligence development is of extreme importance.

**Methodology.** Researchers from different fields of science, ranging from neuro-scientists, psychologists, philosophers to the experts in computer science and programming, mathematicians and economists are focused on the technological and conceptual problems of artificial intelligence. It results from the peculiarity of the research object, i.e a broad interpretation of the term "artificial intelligence" and its emergence as an interdisciplinary idea.

The research of the theoretical and practical foundations of artificial intelligence were conducted by D.A. Pospelov (1992), G.S. Osipov (2009), V.L. Gorokhov (2011), S.L. Sotnik (1997), V.M. Plotnikov (1995), P.A. Gorban (1998), A.N. Kolmogorov (1968), M. Minsky (1954), A. Turing (1955), J. McCarthy (1997), J. Copeland (1993), J. Paquet (2003), S. Russell and P. Norvig (2006), N. Wiener (1948), W. McCulloch (1993), C. Shannon (1993), A. Becla (2012) and others. They examined the technological issues of artificial intelligence, however, a modern aspect of artificial intelligence as the basis for the formation and development of cognitive economy has been left unattended.

Therefore, the purpose of this paper is to analyze the existing approaches to creating artificial intelligence and determine its place in the formation of cognitive economy.

**Results.** Artificial intelligence as an independent scientific field appeared in the middle of the XXth century. The main factors of forming the theoretical and methodological basis of research in this area are, firstly, the development and practical implementation of the first computers with the von Neumann architecture, secondly, the formation of a theoretical framework of mathematical calculations, the theory of algorithms, thirdly, the achievements in the study of the mechanisms of functioning of human brain and higher nervous activity of animals.

At that time the stage of development of the economics was determined by the information revolution, the emergence of economic cybernetics as the science of economic systems management and the revision of the traditional theory of rational behavior in economic analysis (Egidi and Rizzello, 2003).

These scientific shifts resulted in the emergence of the alternative economic outlook with the emphasis on the role of knowledge and innovation, on cognitive structures research, on renunciation of Newtonian model of equilibrium in favor of the study of adaptive or Shumpeterian efficiency and chaotic evolutionary processes (Paquet, 2003).

Such sciences as cognitive psychology and cognitology provided fundamental basis of general principles of human activities in the economic sphere and new theories of behavior of economic actors. Thus, cognitive economy offers an interdisciplinary approach to the study of problem solving, making choices and decisions, to the explanation of the nature and evolution of organizations and economic institutions in the conditions characterized by structural uncertainty (Egidi and Rizzello, 2003).

The attention of researchers was focused on determining the fundamental principles of human thinking, on organization and mechanisms of knowledge formation and its use in social and economic activities.

Cognitive processes, which include perception, memory, attention, action, decision-making, imagination and emotion are studied by cognitive science both from the point of view of brain activity and other biological manifestations, and from the point of view of information flows and data processing.

Application of the cognitive paradigm facilitates understanding of how human brain performs the functions of data processing, as well as how computer as an artificial system can initiate or at least simulate cognitive mechanisms of human intelligence which leads to synthesis and integration of both biological and information component of these processes for the creation of artificial intelligence.

The essence of the term "artificial intelligence" can be considered from 2 main perspectives. On the one hand, "artificial intelligence" refers to the systems that have a human mind in terms of a complete machine reproduction of creative and intellectual abilities of humans. On the other hand, "artificial intelligence" refers to systems that use the rational apparatus of human thinking for solving intellectual problems (Russell and Norvig, 2006: 35).

Human cognitive activities and thinking result from the sequence of brain procedures, i.e. sets of elementary operations. Physical realization of cognitive codes is the manifestation of human mind. Besides, human behavior is the cause-effect order of operations based on these codes. So, the analogy with computer operations can be traced, therefore cognitive processes can be considered, to some extent, as a special type of computing (Pylyshyn, 1984).

There is no universal definition of artificial intelligence, so it is expedient to consider the common points:

- it is a scientific and technological approach to the development of intelligent machines as well as computer software, that is also associated with the use of computers to understand human intelligence (McCarthy, 1977);
- it is a part of computer science, with the task of rational judgments reproduction by means of computer systems and other artificial devices (Smolin, 2004);
- it is the ability of the system to create programs for solving the tasks of certain complexity and the ability to solve them in the processes of self-study (Iluasov, 1986);
- it is the scientific field, within which the tasks of hardware or software simulation of human activities traditionally considered as intelligent are defined and solved (Averkin et al., 1992).

In general, artificial intelligence systems are focused on solving the informal or unstructured problems, which have such features as: incompleteness, ambiguousness or contradictoriness of input data and knowledge of the subject area; the lack of algorithmic solutions; symbolic representation of a problem; the expression of the task

purpose without precisely defined objective function; wide range of possible solutions; the dynamics of data and knowledge.

It has been mentioned above that there are 2 main directions of artificial intelligence research: pragmatic and bionic. Pragmatic direction is based on the assumption that human mental activity is irrational. Within the pragmatic direction researches do not consider the conformity between the structures and methods used by computers and the structures and methods used by humans in similar situations, they consider only the final results of specific tasks.

There are 3 target areas in pragmatic direction in terms of the final result:

- the creation of artificial intelligence tools, which include languages for artificial intelligence systems, deductive and inductive methods of automatic software synthesis, linguistic processors, knowledge bases, cognitive graphics systems;
- the development of methods and models of knowledge presentation and processing, which include a logical model of knowledge presentation, production models, semantic networks, frames etc.;
- intelligent programming, which includes games, natural language software, painting and graphics software.

Bionic direction is based on the feasibility of both the reproduction mechanism and the structure of human brain in artificial systems and the obtaining of similar results by solving intellectual tasks.

Bionic direction of the artificial intelligence research uses the following approaches:

- neurobionic approach: the creation of artificial neurons similar to the neurons in human brain and formation, on their basis, of the artificial intelligence application systems – neural networks. The new research field – neuroinformatics – appeared within this approach. The practical output of neuroinformatics was the creation of neurocomputers;
- structural and heuristic approach: the creation of multi-agent systems on the basis of knowledge about the structure of an observed object;
- homeostatic approach: the use of genetic algorithms in artificial intelligence systems based on the principles of natural systems evolution and adaptation under the influence of a changing environment ([www.aiportal.ru](http://www.aiportal.ru)).

The practical application of the research outcomes is the formation of intelligent information technologies that are prevailing in 5 technological paradigms on which the cognitive economy is built. Intelligent information technologies enable the creation of the class of intelligent systems which are widely used in different fields of economic activity.

These intelligent systems are:

- expert systems contain the knowledge and analytical skills of one or more experts on a certain application field and are capable of making logical conclusions based on that knowledge, thereby providing the solving of specific problems without experts; these systems are used to analyze investment projects, state of foreign exchange, money and stock market, creditworthiness or financial condition of enterprises and banks;
- decision support systems – interactive computerized systems that use the data and models to help decision makers in solving semistructured tasks;

- OLAP-systems: used in business analytics, are the tools for online analytical processing;

- intelligent agents and multi-agent systems: are used for solving the problems that are difficult or impossible to solve with a single agent or monolithic system, such as online trading, modeling social structures etc. (Subbotin et al., 2009).

**Conclusions.** Thus, in general terms, artificial intelligence is an interdisciplinary approach which defines and solves the problems of hardware or software simulation of human cognitive and intellectual activity.

The implementation of artificial intelligence in the context of reconstituted human higher nervous activity and consciousness is being questioned at this stage of development because of the lack of clear definition of the human intelligence nature. The implementation of artificial intelligence or intelligent systems in economic activities is the field of relevant scientific researches because the results of the practical use of such systems prove to be highly effective.

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### КНИЖКОВИЙ СВІТ



#### СУЧАСНА ЕКОНОМІЧНА ТА ЮРИДИЧНА ОСВІТА ПРЕСТИЖНИЙ ВИЩИЙ НАВЧАЛЬНИЙ ЗАКЛАД **НАЦІОНАЛЬНА АКАДЕМІЯ УПРАВЛІННЯ**

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**Маркетинг: Підручник / За заг. ред. д.е.н., проф. М.М. Єрмошенка, д.е.н., проф. С.А. Єрохіна. – К.: Національна академія управління, 2011. – 632 с. Ціна без доставки – 140 грн.**

Має гриф підручника від МОН України.

У підручнику в концентрованому вигляді викладено зміст усіх нормативних дисциплін по спеціальності «Маркетинг». По кожній з дисциплін базового курсу пропонуються контрольні питання, тести, глосарій і література.

Для викладачів, майбутніх бакалаврів і магістрів, аспірантів, маркетологів-практиків, наукових працівників, а також для всіх, хто цікавиться сучасними технологіями маркетингу.

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